

Vermont Farm Methane Project Quarterly Report

Prepared by: Jeffrey W. Forward and Dan Scruton

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Introduction:

The Vermont Department of Public Service (DPS) and the Vermont Department of Agriculture (AGR) have received a total of \$695,000 from appropriations from the federal budget over the past several years to promote the use of methane recovery technology on Vermont dairy farms. This technology has the potential to help farmers with their nutrient management plans and at the same time provide additional on-farm income. The goal of this project is to identify and help overcome key strategic hurdles to widespread adoption of methane recovery technologies by Vermont farmers.

The project was designed to consider methane recovery in a broad context, taking into account its potential benefits as a component of a comprehensive nutrient management system, as a renewable energy source and as a strategy for greenhouse gas reduction. The implementation plan calls for using one third of the money for project administration and outreach, one third toward research and development and one third to be used for cost share of installations.

PROJECT ACTIVITIES July 1 - September 30, 2002

ORGANIZATIONAL:

Biomass Energy Resource Center, Inc.

The Vermont Methane Project established a part time staff position at the Biomass Energy Resource Center (BERC) that will be specifically devoted to this project. BERC is a not-for-profit private corporation with the mission of promoting and developing biomass energy projects. This is a project oriented organization that hopes to work on biomass projects in Vermont, the Northeast and globally. Vermont has considerable experience in small and medium scale biomass projects and the goal of this organization is to export that expertise by facilitating specific projects.

Project Advisory Committee:

We do not have a Project Advisory Committee scheduled at this time. We are in the process of re-evaluating our outreach strategy and will adjust it based on the new reality since the group net metering law passed. Once we have worked out a proposed strategy, we will convene a project advisory committee to solicit their input.

POLICY INITIATIVES:

S. 264 Renewable Energy Bill

The Vermont legislature debated the fate of S. 264 up until the very last days of the legislative session. Ultimately the bill did not pass. However, the section of the bill that dealt with group net metering for farm based systems was attached to another bill, S. 138 and that bill did pass. We believe this law will change significantly the incentive to install methane recovery systems on Vermont Dairy farms.

Our next steps will be to re-evaluate our outreach strategy and reconsider what kind of technical support we should be providing Vermont dairy farmers. Our goal is to develop a viable market for the use of methane recovery technology on Vermont dairy farms that can stand on its own without the ongoing support of subsidies. The net metering law should go a long ways toward solving many of the return on investment issues. We are in the process of determining how we can best support the private sector in developing products and services that will ultimately serve this emerging market.

RESEARCH AND DEVELOPMENT

Foster Bros. Dairy Farm research and demonstration site:

Foster Bros. have a two chambered side-by-side digester that they have been using successfully for over 15 years. The Vermont Methane Project has isolated these into two separate digesters so that we can experiment with various materials and technologies and still maintain a control that we know works. Fosters began loading the digester in December of 2000 and has been producing biogas generated electricity since January 2001.

A mechanical problem to the engine (The engine had run for over 73,000 hours), followed by an electrical problem, has the system currently off line. Dan Scruton, Stan Weeks and Spencer Bennet (the original builder of the Foster system) have been to the site and have set up the next research trial to be run as soon as the system is back on line. We will be doing a trial to determine if the steam injection system has decreased the retention time of the system. We are hopeful that we have cut the time needed in the digester in half to around 10-15 days. If this is true we will be able to decrease digester size without the need to use thermophilic temperatures. We also discussed the repair to the leaks in the cover system and some other changes to the experimental side that we may pursue. The retention time study will only use one side of the digester so the changes can be made while the study is going on in the other side. We are getting prices to determine the cost of the repairs and improvements.

Feasibility Studies / Inquiry follow-ups:

Jeff Forward and Dan Scruton originally contacted 17 farms that expressed interest in this project. We visited 13 of those and completed several pre-feasibility studies. Based on the high initial capital cost of anaerobic digestion, the reduced electrical demand of many dairy farms due to utility conservation programs and the low price paid for wholesale electricity, it was difficult to find a situation that had a positive cash flow strictly on electrical benefits. Our conclusion was that the typical farmer who would be interested in pursuing this technology was likely to be someone who has a relatively large herd, one who is sophisticated enough to want to take on a new technology and one who is interested in managing his nutrient loads.

With the passage of the net metering legislation, the cost effectiveness analysis for these initial feasibility studies could change significantly. We are considering going back to some of the more promising initial feasibility studies and re-running the financial analysis based on group net metering.

Also this quarter Dan Scruton has been continuing to work with specific farms:

Addison County digester/composted bedding system dairy:

The system is sized for 1000+ cows with farmstead netmetering. The manure will be separated with the liquid going to the digester and the solids going to compost/drying system.

We filed for an extension with NRCS and the Otter Creek Conservation District (our partners on this project) for the digester/composted bedding system we have been working on. The construction of the system has been delayed due to new design information that needs to be investigated on the composting side and cash flow issues due to the dramatic drop in the price of milk. We have visited a farm using composted manure solids for bedding and the prospective farmer is optimistic enough on the suitability of the process to make good bedding, that the system design is being expanded to enable the composting all of the manure solids from the barn. Below is an updated time line for the anaerobic digester/composted bedding system project.

- October-November 2002 Block diagrams and initial design drawings for the digester/compost/bedding system. Some purchasing may start as opportunity and need arises. (Dan Scruton – Stan Weeks)
- December 2002 – January 2003 Application to Public Service Board for Farmstead net metering (Dan Scruton, CVPS and Farmer)
- January – February 2003 Site specific design drawings and specifications for digester (Stan Weeks and contractor(s))
- February –March 2003 Site specific design drawings and specifications for compost/ bedding system (Stan Weeks and contractor(s))
- March 2003 Construction bids finalized (Farmer, Dan Scruton, and Stan Weeks)
- April - July 2003 Install system
- August-September 2003 Split-herd mastitis study (to be repeated, if needed, in cold month) (Dan Scruton and UVM)
- October – December 2003 Write informational sheets on system performance and distribute or get incorporated into other materials that will be distributed. (Pam Stefanek)

Caledonia County whole manure system:

A 500 cow farm that was interested in a digester and Dan visited the farm last summer. The farmer decided they were interested in a system if it would be cost effective. The options were discussed with Stan Weeks but the electrical savings to the farm were insufficient to justify a system at this time. The farm is interested in pursuing a digester if economics change so that a system is cost effective.

Chittenden County whole manure digester:

This farm was one of the original farms studied in Phase 1 of this project. At that time they did not go forward with a system. They are now planning a new facility and are interested in including a digester in that facility. Stan has done a preliminary proposal and it looks promising that a system will be included if they build a new facility.

Franklin County whole manure system:

This 600+ cow farm approached the project and was evaluated last winter. Vermont Public Power Supply Authority (VPPSA) is interested in an arrangement with the farmer that would provide them with renewable power and have a positive return to the farm. Options discussed have ranged from a utility owned and maintained system to a farmer owned farmstead netmetering system. Dan has been working with VPPSA and the farmer to help answer questions on the options and there should be a proposal soon. The farmer is interested in building a system in the spring if it is determined that one makes economic sense.

Orange County farm with sand bedding:

A farm in Orange County was evaluated in Phase 1 of this project for a system and it was decided at that time it should be postponed until we learned more about dealing with sand in a digester. An engineering firm has approached the farm and suggested some alternatives that may work with the sand. Dan is working with them to try and find funding for a feasibility study to answer the questions surrounding the costs, practicalities and other issues on this system. It is hopeful that a study could be done this winter at the farm.

Orleans County Dairy:

Jeff Forward initially visited this farm. They have over 700 cows and were interested in more information. The problem is the farm lies within several utility service territories so that farmstead netmetering is not an option. A system to just provide power to the milking barn is of marginal economics. Dan is following up on this farm and will be discussing options to see if a digester makes sense for them.

Orleans County farmstead cheese operation:

A farm is in the planning and early construction phases of a farmstead cheese operation and is interested in a manure/whey digester to generate heat for the processing plant and reduce odor from the manure and whey. They are planning on starting small and will be milking less than 50 cows. Dan and Stan are working on options for this operation.

Windham County odor control/bedding system:

A 100 cow dairy in Windham County approached the project with an interest in a digester. It has been decided that electrical generation would probably not make sense now but may in the future. Odor control

was the driving force for the system. NRCS, Dan and Stan have visited the farm a number of times. Stan has designed a digester system for them that will integrate with the manure storage system proposed by NRCS. They are planning on building the system next year.

OUTREACH:

Methane Focus Group Meeting:

In order to better understand how the Vermont Methane Project can best support the emerging market for methane recovery systems, the DPS sponsored a one-day focus group on Thursday, August 29th. The target audience was primarily engineers who have expressed an interest in the project over the past year. The purpose of the focus group was to answer the question, “How can the public sector be helpful in stimulating the market for methane recovery on Vermont dairy farms?” The DPS hired KBB Energy, a company with considerable experience in bringing new technologies to market, to facilitate this meeting. KBB Energy broke down the farm methane “product” into multiple discrete modules such as manure handling, digester design, energy harnessing, and data collection so that the individual modules can be explored for their strengths and weaknesses in Vermont. In a broader context, this strategy also illustrated how careful consideration of each module is essential to successful projects. A report on the meeting and an action plan is attached.

Tours:

One of the benefits of setting up our research project at Foster Brothers Farm in Middlebury is that it is an excellent demonstration site. The Fosters have nearly 20 years of experience with this technology and related systems and they are very excited about some of the experiments we are performing there. Tours of the Foster Bros. facility allow us to display some of our experimental technologies and it gives us a good opportunity to discuss with other individuals, groups and organizations possibilities for collaboration.

This past quarter, on September 23, Jeff Forward conducted a tour of the Foster Bros. farm for Joseph Abe of the Northeast Midwest Institute and Ed Toombs and John Stewart of Highland Power. Mr. Toombs and Mr. Stewart are developing a reciprocating engine that can run on low Btu gas and were interested in learning more about biogas and particularly Foster’s experience mixing diesel and biogas. Mr. Abe is a policy analyst for a Washington DC Non-Government Organization and was interested in our overall project and the possibilities it holds for farmers throughout the country.

Out-of-State Field Trips:

Farm tour to Mason Dixon Farm in Pennsylvania:

Dan took a group to Pennsylvania to look at the facilities at Mason Dixon Farm. This 1700 cow dairy has the longest running farm methane electrical generation digester in the country. It was interesting to hear about the ups and downs of getting the system designed and running. The farm also is composting the manure solids from the digester into bedding.

Odor control was demonstrated as they operated a boom style pivot irrigation system that was spraying liquid manure from the digester onto a field of corn. You could smell that it was not water but it was not at all as strong as a typical lagoon being stirred.

The composted manure solids have been used for bedding for 2 years and their somatic cell counts are excellent indicating that there is not an elevation in mastitis from the bedding. It was noted that in those facilities they were able to use a wetter product than most of felt we could use in Vermont but it was encouraging that we seem to be on the right track in investigating the use of composted manure solids as bedding.

Integrated Manure Management Conference, London, Ontario:

Jeff and Dan attended a manure management conference in Ontario. Dan gave three presentations.

The first presentation was on “Changing the Rules”.

Dan outlined hurdles we have found here in Vermont. It was very interesting to see that their assessment of the situation is very much like ours. The hurdles were: marginal economics; Traditional designs only suitable for large farms; Complicated designs causing high maintenance; long retention times require large digesters; Gas quality is poor as it is low BTU and has H₂S; sales to the grid are complicated and the price is low; little or no existing service industry; odor, pathogen and other ancillary benefits are not quantified; and the farmers are already working long days and do not need or want more headaches. It was explained that we narrowed those hurdles down to the ones we could address and the ones that needed rule changes. Dan explained that we could at least partially affect the economics, the design issues and the maintenance issues. The one that needed rule changes was the utility interconnection and payback and Dan explained how the Vermont farmstead netmetering program is set up and why that makes such a difference. In his example a 1000 cow dairy with single meter netmetering has a 7 year payback. With the other buildings added, even with the added cost of a larger system, the breakeven was lowered to 6 years and the farmer would have the added \$20,000 a year of savings revenue into the future.

The second talk was about our research advancements.

Dan started by telling them of the attached growth study done by Steve Hoyt that showed you could reduce retention time with attached growth. Most of the time was spent describing the Foster Bros. set-up. They agree we are lucky to have a site with experienced operators that want to see the technology move forward. Our biggest success to date there has been the steam injection. We have shown that the steam injection technology does work and now we need to look at ways to integrate it into whole manure system designs.

The third talk was part of a panel where Dan was talking about the economics of small systems.

It is hard to imagine that 1000 cow dairy is considered a small system but compared to the community systems and the large beef (20,000+ head) facility that were also discussed it was.

Dan started with a discussion on the difficulty of justifying systems solely on the electrical payback and that ideally there would be a payment of some sort to cover the societal benefits like odor and pathogen reduction. He then went through conclusions we drew from the feasibility studies done in Phase 1.

The economic example he used was a 1000 cow dairy facility. Under a variety of scenarios, Dan estimated the number of years it would take for the system to break even.

The assumptions used for the examples were:

- Adult animals only
- All young stock and ancillary buildings on separate meters and manure system
- 1000 milking cows plus 200 Dry cows at 2.25 kWh per cow per day ~ 1,000,000 kWh per year potential output
- System cost \$290,000 to 340,000 US
- Loan cost 7% interest
- 20% down payment

The basic system was a single meter supplying only the milking barn (Cost \$290,000 to match output to system). With \$50,000 (US) per year in savings at milking barn (500,000 kWh used) and a maintenance cost of 1.5 cents per kWh or \$7,500 per year, there is around a 7 year payback.

If you add to that a payment \$10,000 per year for odor control, the breakeven date reduces to about a 5.5 year payback. If you add a pathogen reduction benefit of \$10,000 per year, the breakeven date reduces to around 4.5 years.

With Farmstead Net Metering the cost of the system goes up to generate the extra output (about \$340,000 capable of 1,000,000 kWh per year). The example farm had 6 houses using about 72,000 kWh per year and miscellaneous barns, garages, composting facility or other farm related uses of around 150,000 kWh. The maintenance cost goes up to \$15,000 (\$7500 increase) per year but the payback increases by \$20,000 per year. The excess power is not used but is “banked” for periods of under generation. This drops the breakeven to around 6 years. An annual payment of \$20,000 for odor and pathogen control drops the payback to around 4 years. If instead of banking the excess power it is sold at 6 cents per kWh there would be around \$15,000 more income and a faster breakeven at around 3.25 years. Each 1 cent of payment for renewable power further increases the income by \$10,000 further reducing the payback. With an upfront payment of \$50,000 for greentags instead of annual payment the breakeven point can be less than 3 years. However the upfront payment is a one-time payment verses an ongoing payment so both sides need to be investigated.

Dan also attended a seminar sponsored by the Ontario Ministry of Agriculture on digester design. The seminar was presented by an engineer from Switzerland who has installed 15 systems. There was a good discussion and exchange of ideas.

Also useful to Vermont was information gained on alternative manure handling equipment that may be applicable to Vermont.

For more information on the Vermont Farm Methane Project contact:

Jeff Forward
Biomass Energy Resource Center, Inc.
PO Box 615
Richmond, VT 05477
(802) 434-3770
FAX: (802) 434-2344
forward@gmavt.net

Dan Scruton
Vermont Department of Agriculture
116 State Street
Drawer 20
Montpelier, VT 05620-2901
828-3836
dan@agr.state.vt.us

Attachments:

- Letter of invitation to August 29, 2002 Methane Focus Group
- August 29, 2002 Methane Focus Group Agenda
- August 29, 2002 Methane Focus Group Report
- Ontario Conference Brochure
- Jeff Forward's Ontario Conference trip notes
- Dan Scruton's Presentation Handouts from Ontario conference